A 2005 Look at the

Renewable Energy, Energy Efficiency, and Smart Energy Industries

in Washington State

Commissioned by the Energy Policy Office,
Washington State Department of Community,
Trade and Economic Development

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Executive Summary

Globally, the economic, security, environmental, and health effects of our current energy sources raise more and more concerns each year. At the same time, interest in renewable, cleaner, and safer alternatives also grows. In this climate, the Washington State Energy Policy Office commissioned this follow-up report to its 1998 study, The Next Generation, which provided an economic snapshot of the renewable energy and energy efficiency industries in Washington State. The Energy Policy Office seeks a current assessment of the size, health, and characteristics of Washington's clean energy industry to help guide state energy and economic development policy as the state's energy needs grow.

Washington relies on large hydropower for more than 60% of its electricity. While this is a clean energy base, its geographic opportunities have been fully developed, and only efficiency upgrades at existing facilities can offer more output. Yet the Northwest Power and Conservation Council estimate that in the next twenty years the Pacific Northwest electricity industry will need to add nearly 7,000 aMW of power resources, approximately a 40% increase to our existing power supplies[1]. Washington's clean energy industry has a very real opportunity to supply 60% of this twenty-year electricity resource need. Therefore, this study quantifies, through revenues, employment, and wages, emerging clean energy industries that might provide for the state's growing energy demands.

Clean energy industries include energy efficiency; smart energy, using technological advancements to improve all steps of the energy production-to-end-use consumption process; and renewable energies, such as solar, wind, fuel cell, geothermal, and biomass. In 2004, Washington had 241 organizations working in at least one clean energy industry. These organizations employed almost 8,400 people at an average wage of $60,000. Their total revenues exceeded $2.1 billion for the year. The most common clean energy industry in the state was energy efficiency, with 133 organizations, and smart energy and solar energy were runners-up with 48 and 40 organizations. Clean energy organizations were most common in the Puget Sound region of the state, with 144 located in King, Kitsap, Pierce, Snohomish, or Thurston County. Yet the highest per capita jobs and revenues were in Eastern Washington. While the services sector (such as professional, scientific, technical, and management) represented the most organizations, at 116, the manufacturing sector had the highest revenues, $853 million, and paid the most in wages, $163 million.

Washington's clean energy industry continues to grow in its magnitude of revenues, its technical opportunities, and the number of Washingtonians it employs. The 1998 study found clean energy to be larger than the wholesale apple industry. The 2004 survey finds continued growth that puts the clean energy industry larger than both the state's logging industry – $1.9 billion – and coffee/espresso shop industry – $1.7 billion.

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I. Foundations of this Report

Purpose and Definitions

Eight years ago, the Washington State Department of Community, Trade, and Economic Development's Energy Policy Office commissioned a study of the state's energy efficiency and renewable energy industries. Energy resources are an ever-growing public policy concern, as well as private sector concern, and the 1998 study showed that the renewable and efficiency industries were already vital to the state, with almost $1 billion in annual sales and sustaining more than 3,800 jobs. The agency's Energy Policy Office commissioned this follow-up study, based on 2004 data, that looks at both industries again as well as the smart energy industry. The intent is that by tracking these industries, the state will better understand their trends, health, and needs. With that information, the state can then shape policy accordingly such as by focusing economic development efforts on the industries, or striving to make clean energy a cluster industry in Washington that leads the country.

This study follows the 1998 study's definitions of energy efficiency and renewable energy. The energy efficiency industry is an unstructured collection of researchers, designers, engineers, manufacturers, construction companies, advocacy and policy groups, regulators, and retailers who focus on processes and products that use energy more wisely in current practices. Because so many businesses can touch incidentally on this industry – for instance, any hardware store that sells compact fluorescent bulbs could be considered part of this industry – this study follows the 1998 study's example of counting only those organizations who voluntarily identify themselves as related to energy efficiency or whose primary business is in energy efficiency. Voluntarily identifying means, for example, being a member of an energy efficiency association or listing your company with a government agency as a contractor that does energy efficiency work. This update adds a component to energy efficiency that the 1998 study did not include: public and private electric and gas utilities. Washington utilities' work in energy efficiency is important enough to the state as a whole that this 2005 study counts their efficiency programs, though not their entire business.

Another significant area of energy efficiency is co-generation. In co-generation, industrial plants use waste heat to create energy, helping to keep enterprises competitive by making dual use of fuel. Data on co-generation are not included in this study, however, for two reasons. First, co-generation revenues are embedded in enterprises' overall revenues, and second, because jobs created from co-generation occur at the design and implementation stage, while the on-going jobs at the enterprise are generally part of the on-going operation of the facility.

The renewable energy industry is defined by energy sources that do not rely on fossil fuels or large scale hydropower, and includes solar, wind, biomass, geothermal, fuel cell, and small scale hydro. This report counts the same types of organizations as listed above for energy efficiency, and includes organizations that work on fuel cells and electric vehicles, though they may or may not be based on renewable resources.

The smart energy industry, not included in the 1998 study at all, is the newest and least easily defined of the three. It is the application of digital technology, advanced materials, and other innovations to the energy network — the addition of electronics and "intelligence" to the generation, distribution, and consumption of electricity. Smart energy technologies are under development today with the goals of reducing costs, reducing environmental impact, and increasing reliability. An example of smart energy is digital metering that allows meter reading over the internet or phone lines. These data can be relayed to the utility almost continuously to allow the utility to purchase or sell power in real time. The next generation of household appliances could have computer chips, for example, clothes dryers with chips that adjust their energy use when the electric grid is stressed[2]. Applied in large numbers, these could help balance an electricity system.

The 1998 and 2005 studies are similar in their definitions, as discussed above, but quite different in their methodologies and, as a consequence, their types of results. The 1998 study did some quantitative analysis using confidential state revenue and employment data, but was primarily a qualitative study that relied on in-depth interviews with more than 50 people from industry companies, associations, academia, nonprofit organizations, and government agencies. This 2005 follow-up report is almost entirely quantitative, with a far greater emphasis on building an accurate, thorough database of industry organizations and analyzing those data. As a result, this report is heavier on the charts and graphs, and lighter on the text, compared to the 1998 study. For more information on how this study was conducted, please see the section on methodology.

Findings of the 1998 Study

The 1998 study found that in 1997, there were 274 organizations in Washington State that worked in energy efficiency or renewable energy. These firms employed 3,802 people, paid $161 million in wages, and had revenues of $924 million: more than Washington's wholesale apple industry. Energy efficiency organizations represented about half of the number of firms, but more than three quarters of the jobs, wages, and revenues. The table below shows the detail of these industries, and breaks each industry down into business categories: by type of renewable energy and, for the energy efficiency firms, by type of business. Wages and revenues are shown in 1997 dollars and also in 2004 dollars, for easier comparison to this study's findings.

Solar energy was the largest category of renewable energy, with 69 companies. It employed 424 people, at total wages of $13.7 million, and realized revenues of $71 million. Within energy efficiency, energy service companies and related engineering firms were the most significant type of business, with 47 companies. They employed 1,292 people, at total wages of $68 million, and realized revenues of $431 million.

Geothermal energy was the smallest category of renewable energy. While the study identified 10 firms associated with geothermal energy in Washington, telephone interviews revealed that they were no longer in the geothermal energy business, and therefore no jobs were associated with that category.

Table1. Washington's Energy Efficiency and Renewable Energy Firms, 1997

	Firms #	Revs ($000s)	Revs (2004 $000s)	% of Subtotal	Wages ($000s)	Wages (2004 $000s)	Jobs #	% of Subtotal
Renewable Energy								
Biomass, Biofuels, Muni. Solid Waste	26	54,240	65,251	37%	11,940	14,364	325	36%
Electric Vehicles	6	3,026	3,640	2%	570	686	16	2%
Geothermal	10	124	149	0%	12	14	0	0%
Small-scale hydroelectricity	21	15,452	18,589	11%	5,384	6,477	119	13%
Solar, Elec. Storage, Inverters	69	71,083	85,513	48%	13,692	16,471	424	47%
Wind	6	2,255	2,713	2%	903	1,086	20	2%
General	2	635	764	0%	202	243	3	0%
Subtotal	*140*	*146,815*	*176,618*	*100%*	*32,703*	*39,342*	*907*	*100%*
Energy Efficiency								
Consultants	11	4,553	5,477	1%	1,382	1,663	38	1%
Controls	13	122,347	147,183	16%	13,089	15,746	308	11%
Electrical Suppliers and contractors	19	56,980	68,547	7%	13,022	15,665	333	11%
Energy Service Companies/Engineers	47	430,901	518,374	55%	67,814	81,580	1,292	45%
Heating, Ventilation, Air Conditioning	8	17,558	21,122	2%	5,025	6,045	106	4%
Lighting	16	116,233	139,828	15%	20,952	25,205	652	23%
General	20	28,343	34,097	4%	6,593	7,931	165	6%
Subtotal	*134*	*776,916*	*934,630*	*100%*	*127,877*	*153,836*	*2,895*	*100%*
Total	**274**	**923,731**	**1,111,248**		**160,580**	**193,178**	**3,802**	
Energy Efficiency as % of Total	49%	84%			80%		76%	

Predictions from Seven Years Ago

The 1998 study relied significantly on interviews with industry organizations. From these interviews, the study collected the clean energy industries and component industries impressions on where they were going.

In general, the short-term prospects for renewable energy and energy efficiency industries were not strong, due to low natural gas prices, highly efficient gas turbine generators, and increased competition in electricity generation among utilities due to deregulation, making the utilities spend less on efficiency and renewable energy programs. However, company leaders and industry experts held more optimistic views on longer-term prospects.

Regarding the solar industry, global demand was expected to grow and Washington, already a U.S. lead in solar technologies, was considered a prime place for further growth. Biomass on the whole was not expected to grow, largely because the waste conversion process was too costly and timber bio-product availability was dwindling as the timber industry downsized. The one exception was in pellet stoves, which comprise a very small market sub-industry, but were growing significantly. The small hydropower industry was expected to decline, however there were hopes that increased overseas demand would boost the industry in Washington. Demand for wind energy technologies was predicted to increase significantly globally, but how this would impact Washington's industry was unknown; industry experts felt that the state was on the cusp of a choice to grow or let go of the wind energy industry. Energy efficiency was predicted to remain strong, growing steadily.

For more in-depth discussions of the renewable energy and energy efficiency industries, their context in 1998, and the predictions made for these industries in 1998, please refer to that earlier study, at http://www.cted.wa.gov/energy/archive/ECONWReport/.

Smart energy was not recognized as a separate sector in the 1998 study. While it was clear that digital technologies were an emerging component of buildings it was not yet recognized how these digital technologies, if broadly applied, might transform the electric energy system.

Methodology, Assumptions, and Data Limitations of the 2005 Update

This 2005 report started with the list of organizations, public, non-profit, and for-profit, from the 1998 study. To that were added:

- a list of smart energy organizations compiled by a consulting firm recently for a study exclusively on smart energy;
- the September 2004 membership list from Northwest Energy Efficiency Council;
- a list of fuel cell organizations from a clean energy advocacy group; and
- a collection of organizations culled from various places, such as the Renewable Northwest Project website, the Energy Forum attendance list, Solar Washington's website, the Sustainable Industries Journal's 2005 Overview, metro area phone book listings for 'energy conservation' 'energy management' and 'insulation', Environmental Yellow Pages listings for 'energy management and conservation', Renew Washington's website list of supporters, and the 2004 NW Renewable Energy Festival vendors.

This long list was broken into three groups: government organizations, firms large enough to have distinct clean energy sections, and all other firms. Government organizations were contacted directly to get employment, wage, and revenue/budget information, then any revenues that were simply passed through to contracts were excluded. The large firms with distinct clean energy groups were similarly contacted to get the employment, wage, and revenue information applicable, or apportioned, just to clean energy work. The government groups and large firms responded relatively well, though not all data were available for all organizations.

The Unified Business Identification (UBI) number was the data starting point for each of the other firms. This number is used by several state agencies to track various kinds of information, including revenue, wage, and employment. The Secretary of State's website and the Department of Revenue's website both offer searchable databases for UBIs. Firms that had either closed or were not in the databases were removed from the study's master list, and the Department of Revenue (DOR) and the Employment Security Department (ESD) then provided data on the resulting list of active UBIs. Individual company data are confidential and only presented in aggregate.

One concern was that the original search net had been cast so broadly that some of the firms for which there now were data might not actually be in a clean energy industry. If a firm was referenced in more than one source or known by Energy Policy Office staff, it was give a 'high confidence' mark and left. If a firm had only one reference, it was marked 'low confidence' and received a phone call and/or email to confirm its participation in clean energy and to ask about any out-of-state business it had. Finally, all high confidence firms were contacted for out-of-state business information to help determine how much the Washington industry is exporting beyond its borders. Reporting of this information is not mandatory, so data from DOR and ESD does not reliably capture it.

All high confidence firm data were combined with government organization and large firm apportioned data to form this study's database for all analysis.

Several assumptions went into the data analysis:

- When a company indicated that about half of its business is out of state, this study assumed 1/4 other states and 1/4 international.
- When a company works in more than one clean energy category, this study allocated employees, wages, revenues, and out-of-state business equally among categories.
- For organizations that do not have sales, such as research and development groups or governmental programs, the annual budget was used as a proxy for revenues, based on the logic that the budget is money that is going into the local economy.
- Many of the public and quasi-public organizations contract out for significant portions of their efficiency and renewables work. The contractors who are used are most likely captured in this study's database. Therefore, to avoid double-counting revenues, this study included only non-contracting revenues (or budget) for those organizations.

While this study's methodology and assumptions are arguably the best way of collecting and analyzing data without administering a very intensive survey, there are some inherent limitations. Relying on organizations to self-identify as part of a clean energy industry will not capture all organizations and therefore underestimates the industry. Yet some organizations who self-identify and whose data are included work outside of clean energy as well, and without apportioning employees, wages, and revenues, data overestimate the industry. Lastly, the Department of Revenue's and Employment Security Department's data are not complete. They include: in-state revenue data for 95% of organizations, employment and wage data for 72%-78%, and out-of-state revenue data for 30%. With employment and wage data for only three-quarters of the businesses, actual state employment and wages are higher than this report shows.

Similarly, because out-of-state revenues are voluntarily reported, with only 28% reported any, it can be assumed that they are actually higher, which would make actual total revenues higher.

These data limitations of self-reporting, not apportioning, and incomplete state records notwithstanding, this report's findings reflect, if only approximately, the size and health of the renewable, efficiency, and smart energy industries in Washington State during 2004.

II. Year 2004 Status

Market and Global Context for Clean Energy

The 1998 study described the energy industry as quickly shifting, and seven years later it is still in flux, with growing competition, new technologies for energy production, and ever-rising concerns about using fossil fuels. 2002 census data demonstrate a very large domestic fossil fuel energy industry, with at least 156,000 organizations employing over 2 million people across the United States[3]. Electricity generation, currently 52% from coal and 17% from natural gas, alone accounts for more than 40% of all U.S. carbon dioxide emissions, 26% of smog-producing nitrogen oxide emissions, 33% of mercury emissions, and 64% of acid rain-producing sulfur-dioxide emissions[4].

Yet some things certainly have changed since 1998. Most notably, crude oil reached $70 per barrel in August of 2005, and while the price of crude oil has declined a bit recently, the U.S. Department of Energy (DOE) expects prices to average near $60 per barrel over the next two years. This, compared to a barrel costing under $15 in 1998. Since 1997, average residential natural gas prices have increased from $5.61 per thousand cubic feet to $9.83 in 2004[†]. More than one energy industry giant has had a significant, well-publicized corporate crisis. Internationally, oil-producing countries are more unstable, as are U.S. relations with them. And concern about the local economic impacts of importing energy is growing: a report from the Arizona Department of Commerce centers on the fact that 60% of dollars spent on energy by Arizonians are not re-invested in the state[5], and a study from the DOE estimates that 80% of dollars spent on energy in Midwestern states leave these states[6]. Given that the energy industry is the largest combined industry in the United States, this out-flow of dollars has a very big impact on the economy[7].

On the flip side, efforts like the West Coast Governors' Global Warming Initiative show more and more commitment to pursuing clean energy. In fact, the 2005 Washington State legislature passed two energy efficiency laws and two renewable energy laws. Several Washington State clean energy statistics include:

- In the year 2000, Washington's electric utilities' relied on hydropower and biomass as their renewable resources for generating electricity. Five years later, the utilities added to their existing base renewable energy resources to include selling a total of 446 million kilowatt-hours of wind powered electricity, 166 million kWhs of electricity fueled by landfill gas, and 304 thousand kilowatt-hours of solar powered electricity to their Washington customers[8].
- In 2005, Washington utilities' sale of electricity generated by non-hydropower renewable energy exceeded 1.1 billion kilowatt-hours or 1.6% of total retail electricity sales in the state[9].
- Total revenues from Washington ratepayers' purchases of non-hydropower renewable energy through utility voluntary programs were $1.9 million in 2004 and exceed $2.5 million in 2005[10].

[†] Residential gas prices reported thus far for 2005 average $11.35 per thousand cubic feet.

On a national level, more than 50% of US energy consumers have green power options[†] and 420,000 consumers participate, approximately 1%, in 34 states[11]. Public and private organizations are publishing analyses on benefits of renewables and energy efficiency:

- Per the Renewable Energy Policy Project, wind and solar electricity production offer 40 percent more jobs than coal, which currently produces 52% of U.S. electricity[12].
- The U.S. DOE found in 2000 that if the U.S. were to triple its use of biomass energy from farm residues and energy crops, farmers and rural communities could realize approximately $20 billion in new income[13].
- Energy efficiency costs significantly less than new power generation: $34 per Mwh[14], as opposed to coal at $47 per Mwh, most natural gas at $51 per Mwh, and wind at $39 per Mwh[15].
- Energy efficiency produces more jobs: 500 megawatts of conserved energy results in 100,800 job years spread throughout the state, whereas 500 megawatts of new coal-generated power leads to 51,600 job years[16].

In short, while the established energy industry still dominates overwhelmingly, reasons for investing in clean energy continue to grow, and public support of clean energy grows, as well.

Findings of the 2005 study

Keeping in mind the data limitations discussed in the previous section, following are the findings of the 2004 clean energy industry data, presented at summary level and then analyzed by clean energy category, *e.g.* energy efficiency, wind, and small hydro; by geographic location in the state; and by business sector, *e.g.* manufacturing, utility, and transportation.

State-wide

In 2004, Washington State had 241 organizations in its clean energy industries, composed of the renewable energy, energy efficiency, and smart energy industries. They employed 8,373 people at an average wage of $60,000, for a total of over $500 million in wages. Their total revenues were $2.1 billion. These organizations include private businesses, association groups, non-profit interest groups, private and public utilities, and government programs. Ninety-three of the organizations worked exclusively in energy efficiency, 49 work exclusively in renewable energy, 22 exclusively in smart energy, and 67 in a combination (10 organizations did not identify their industry).

If we were to look at the most common value among the 241 organizations for characteristics such as size, location, expertise, and type of business, the average Washington clean energy business in 2004 would be a private, professional services business specializing in energy efficiency, located in the Puget Sound region. It would have 45 employees, at an average

[†] Green power options either allow customers to purchase some portion of their power supply as renewable or contribute funds for the utility to invest in renewable energy development.

salary of $59,770, and its 2004 gross revenues would be almost $9 million. Just over half of its business would be in-state, about a third would be somewhere else in the U.S., and about 10% would be international. The table below summarizes the state-wide, summary findings.

Table 2. Washington's Clean Energy Industries, 2004

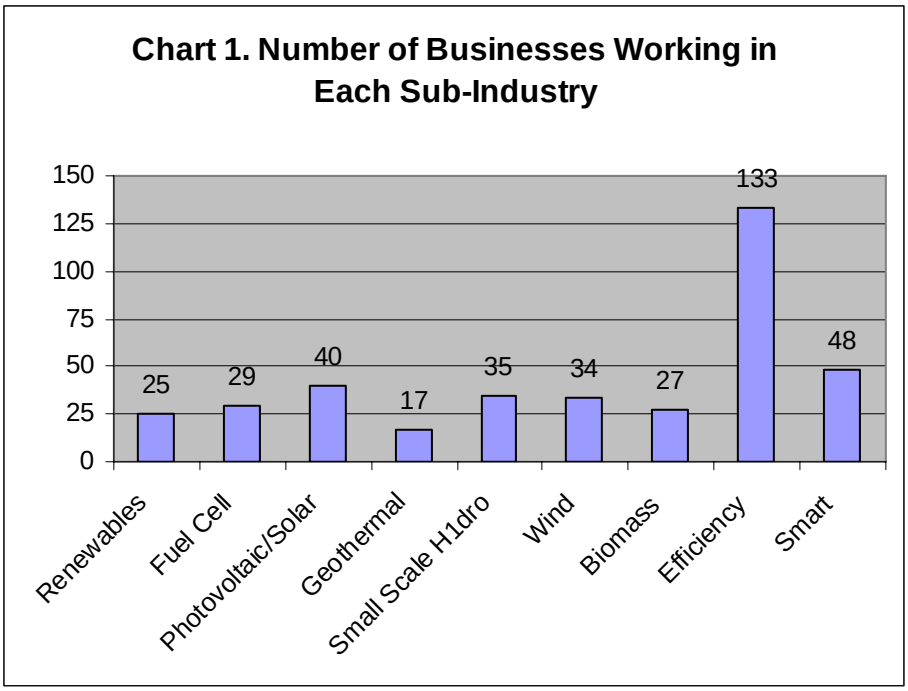
	# Orgs	2004 Employees	2004 Avg Wages	2004 Total Wages	2004 Total Revenues
All Organizations	241	8,373	$59,908	$501,617,149	$2,138,493,292
Energy Efficiency	133	4,279	$60,369	$258,330,893	$878,761,251
Renewable Energy	207	2,259	$56,980	$128,739,681	$783,004,164
Smart Energy	48	1,826	$61,927	$113,054,530	$474,989,955
Unidentified Sector	*10*	*9*	*$37,644*	*$338,795*	*$1,737,922*
Average Organization		45	$59,770	$2,676,278	$8,873,416

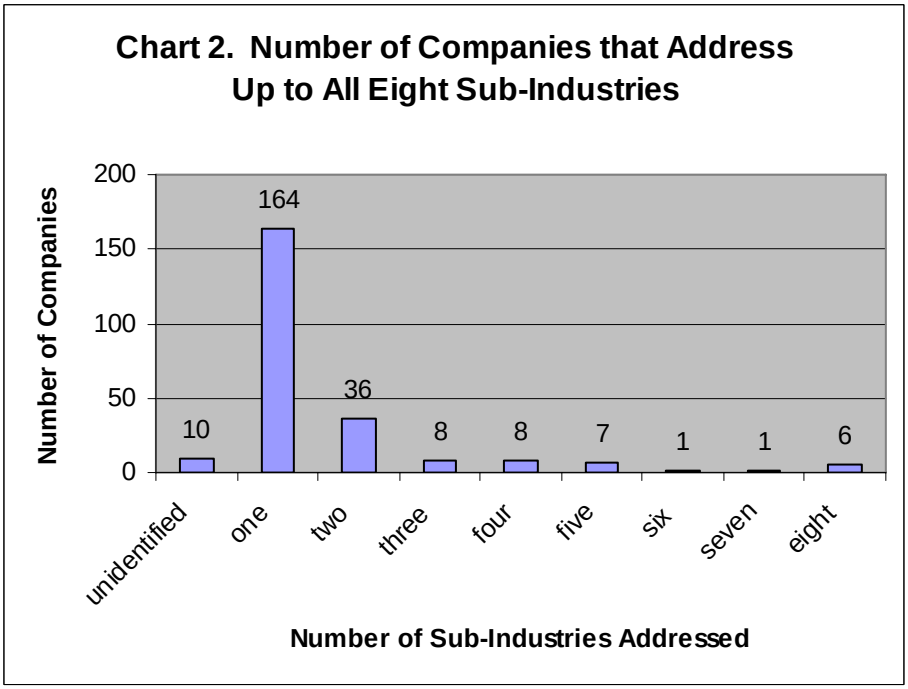
Note: The number of organizations in the efficiency, renewable, and smart industries sum to more than all organizations because many organizations address more than one industry. The employee, wage, and revenue data do sum and represent the amount of employees and dollars exclusive to each industry.

By Clean Energy Categories

The organizations fall into nine clean energy categories: energy efficiency, smart energy, renewable energy in general, and six specific types of renewable energy: biomass, wind, small scale hydro, geothermal, photovoltaic/solar, and fuel cell. Of these nine categories, by far the most organizations, 133, fall into energy efficiency with smart energy being a distant second, at 48. As found in the 1998 study, fewer organizations work in geothermal energy than in any of the other categories, though it is up from 10 in 1997 to 17 in 2004.

One hundred sixty-four of the organizations focus on only one of the clean energy categories, while 67 work in more than one. Six organizations, in fact, work in all eight distinct categories (not including renewable energy in general). The following charts 1 and 2 show these category break-downs.





For each of the clean energy categories, Table 3, below, identifies the number of organizations, how many jobs and their wages that it represents, and the revenues that it produces. Also listed, in italics, are figures for the average amount of business that is conducted outside of Washington. These figures are italicized because they are based on having that information for only 30% of the organizations. These are included for interest's sake, but the

actual percentage of business conducted out-of-state may be significantly different when the data for all 241 organizations are known.

This table shows that the energy efficiency industry is by far the strongest in this list. Given how broad a scope the efficiency industry covers, and how the renewable energy industry is broken down into its component parts here, this is not surprising. Therefore, it might be more interesting to note that smart energy, a new industry which was small enough not to be a distinct category in the 1998 study, is the clear second: its revenues were $475 million, it employed 1,826 people in 48 organizations, and it paid $113 million in wages. Of the renewable energy components, fuel cells and photovoltaic/solar technologies have the strongest presence in the state.

Table 3. Employment and Revenue Data by Industry and Sub-Industry

Industry or Sub-industry	# of Orgs	Employees	Total Wages	Total Revenues	Avg % of business in other state	Avg % of business international
Renewables	25	586	$24,315,806	$220,600,502	*52.5%*	*4.6%*
Fuel Cells	29	510	$27,406,784	$192,693,388	*28.1%*	*10.6%*
PV/Solar	40	389	$24,521,144	$188,272,931	*43.3%*	*14.4%*
Geothermal	17	205	$13,701,658	$35,499,231	*43.3%*	*14.8%*
Small Scale Hydro	35	278	$19,358,700	$60,608,246	*32.3%*	*16.2%*
Wind	34	111	$8,105,035	$43,560,710	*32.5%*	*9.0%*
Biomass	27	181	$12,313,554	$41,769,157	*32.6%*	*31.3%*
Efficiency	133	4,279	$258,330,893	$878,761,251	*33.2%*	*11.4%*
Smart	48	1,826	$113,054,530	$474,989,955	*34.7%*	*17.2%*
Unidentified	10	9	$338,795	$1,737,922		
Totals		**8,373**	**$501,617,149**	**$2,138,493,292**		

- Because only 30% of the organizations identified whether they have out-of-state business or not, actual figures for the final two columns may be significantly different.

- Ten companies did not identify a clean energy category for their work, nor did they indicate if any of their business is in another state or country.

- The # of Orgs in each of the sub-industries sum to more than 241 because many organizations work in more than one sub-industry. Employees, wages, and revenues have been adjusted to reflect only that attributable to a given sub-industry. Adjustments assume that an organization evenly distributes its work among all sub-industries it is involved in.

By Geographic Location

For purposes of analyzing the industries by location, the state is divided by county into six regions, and there is an additional grouping, 'other':

Northeast	Northwest	Olympic Pen	Puget Sound	Southeast	Southwest	Other
Chelan	Island	Clallam	King	Adams	Clark	State-wide
Douglas	San Juan	Grays Harbor	Kitsap	Asotin	Cowlitz	Oregon
Ferry	Skagit	Jefferson	Pierce	Benton	Lewis	Idaho
Lincoln	Whatcom	Mason	Snohomish	Columbia	Pacific	Unknown
Okanogan			Thurston	Franklin	Skamania	
Pend Oreille				Garfield	Wahkiakum	
Spokane				Grant		
Stevens				Kittitas		
				Klickitat		
				Whitman		
				Walla-Walla		
				Yakima		

The Puget Sound dominates in clean energy industries with 144 organizations employing 4,806 people. Their total wages are $312 million, and total gross revenues are $984 million. The southeastern and northeastern regions come in second, but even summed together they don't reach the size of the Puget Sound region's industries. However, when population is taken into account, the northeast and southeast regions prove to be the strongest. The northeast has twice as many jobs (employees) as the Puget Sound, and the southeast has 2 1/2 times the per capita revenues as the Puget Sound. Tables 4, 5, and 6 on the following pages summarize all the data by region.

Table 4. Employment and Revenue Data by Geographic Region

Region	# Orgs	2004 Avg Employees	2004 Avg Wages	2004 Total Wages	2004 In-state revs	Vol. Rptd. Out-of-state revs	2004 Total Revenues
Northeast	30	1,660	$57,409	$95,299,687	$154,942,678	$101,206,488	$256,149,166
Northwest	9	153	$65,926	$10,053,692	$14,928,711	$3,260,194	$18,188,905
Olympia Peninsula	6	15	$34,447	$508,096	$1,558,017	$1,490,749	$3,048,766
Puget Sound	144	4,806	$64,825	$311,529,996	$984,485,931	$197,571,849	$1,182,057,780
Southeast	26	1,550	$48,309	$74,863,805	$441,637,630	$160,554,119	$602,191,749
Southwest	14	144	$48,679	$6,997,669	$15,321,176	$14,917,322	$30,238,498
Other	12	47	$50,571	$2,364,204	$39,618,428	$7,000,000	$46,618,428
Totals :	241	8,373	$59,908	$501,617,149	$1,652,492,571	$486,000,721	$2,138,493,292

Table 5. Sub-Industry Data by Geographic Region

Region	Renewables	Fuel Cell	Photovoltaic/ Solar	Geothermal	Small Scale Hydro	Wind	Biomass	Efficiency	Smart
Northeast	1	7	6	1	6	6	3	15	7
Northwest	0	1	4	1	5	4	0	3	2
Olympia Peninsula	2	2	2	0	2	1	1	1	0
Puget Sound	0	2	3	3	1	4	1	5	3
Southeast	3	1	3	1	1	2	1	7	2
Southwest	16	14	19	11	19	15	17	85	30
Other	2	2	3	0	1	2	4	16	4
Totals :	24	29	40	17	35	34	27	132	48

Table 6. Per Capita Employment and Revenue Data by Geographic Region

Region	Population[17]	2004 Employees per 100,000 Pop.	2004 Per Capita Revenues
Northeast	650,263	255	$394
Northwest	385,714	40	$47
Olympia Peninsula	219,952	7	$14
Puget Sound	3,630,639	132	$326
Southeast	721,539	215	$835
Southwest	595,681	24	$51
State-wide :	6,203,788	135	$345

By Business Sectors

The services sector, which includes professional, scientific, technical, management, administrative, and other services, has the greatest number of clean energy organizations: 116. It also has the highest average salary, at $72,161, but only the third highest revenues. The manufacturing and construction sectors have higher revenues, at $853 million and $423 million, respectively. The manufacturing sector also employs the most number of people: 3,131 in 2004. Tables 7, 8, and 9 on the next pages summarize all the data by business category, and include the percentage that each category represents.

Table 7. Business Sector Data by Employment and Revenues

Business Category	# of Orgs	2004 Employees	2004 Avg Wage	2004 Total Wages	2004 In-state revs	Vol. Rptd 2004 Out-of-state revs **	Total Revenues
Agriculture and Forestry	2	23	$50,835	$1,181,922	$1,375,061	$0	$1,375,061
Utilities	15	195	-	-	$122,427,960	$7,000,000	$129,427,960
Construction	38	1,908	$64,255	$122,571,842	$390,936,785	$32,227,406	$423,164,191
Manufacturing	22	3,131	$52,068	$162,997,726	$498,139,498	$354,604,612	$852,744,110
Wholesale Trade	28	883	$52,877	$46,703,700	$264,173,270	$38,385,032	$302,558,302
Retail Trade	10	66	$67,989	$4,504,246	$5,579,621	$2,451,282	$8,030,903
Information & Transp.	5	107	$40,949	$4,371,318	$7,900,870	$679,224	$8,580,094
Services *	116	1,976	$72,161	$142,596,298	$318,142,922	$50,650,355	$368,793,277
Public Administration	5	85	-	-	$43,816,584	$2,810	$43,819,394
Totals	241	8,373	$57,914	$484,927,051	$1,652,492,571	$486,000,721	$2,138,493,292

Business Category	# of Orgs	2004 Employees	2004 Avg Wage	2004 Total Wages	2004 In-state revs	Vol. Rptd 2004 Out-of-state revs **	Total Revenues
Agriculture and Forestry	1%	0.3%	n/a	0.2%	0.1%	0.0%	0.1%
Utilities	6%	2%	n/a	-	7%	1%	6%
Construction	16%	23%	n/a	25%	24%	7%	20%
Manufacturing	9%	37%	n/a	34%	30%	73%	40%
Wholesale Trade	12%	11%	n/a	10%	16%	8%	14%
Retail Trade	4%	1%	n/a	1%	0.3%	1%	0.4%
Information & Transp.	2%	1%	n/a	1%	0.5%	0.1%	0.4%
Services *	48%	24%	n/a	29%	19%	10%	17%
Public Administration	2%	1%	n/a	-	3%	0.001%	2%
Totals	100%	100%	n/a	100%	100%	100%	100%

** Services include Professional, Scientific, Technical, Management, Administrative, Support, and Other*

*** Organizations are not required to report out-of-state revenues. These figures reflect voluntarily reported revenues, and undercount actuals.*

Table 8. Business Sector Data by Sub-industry

Business Category	General Renewables	Fuel Cells	Photovoltaic/Solar	Geo-thermal	Small Scale Hydro	Wind	Biomass	Efficiency	Smart
Agriculture and Forestry	0	0	0	0	0	0	2	0	0
Utilities	8	0	1	0	1	2	1	8	1
Construction	3	0	6	2	3	4	3	26	4
Manufacturing	2	4	4	0	2	1	2	6	7
Wholesale Trade	2	5	5	1	4	3	1	13	6
Retail Trade	0	2	4	0	2	3	0	3	3
Information & Transp.	1	1	1	1	1	1	1	1	4
Services *	7	17	19	13	21	19	17	71	23
Public Administration	1	0	0	0	1	1	0	4	0
Totals	24	29	40	17	35	34	27	132	48

Business Category	General Renewables	Fuel Cells	Photovoltaic/Solar	Geo-thermal	Small Scale Hydro	Wind	Biomass	Efficiency	Smart
Agriculture and Forestry	0%	0%	0%	0%	0%	0%	7%	0%	0%
Utilities	33%	0%	3%	0%	3%	6%	4%	6%	2%
Construction	13%	0%	15%	12%	9%	12%	11%	20%	8%
Manufacturing	8%	14%	10%	0%	6%	3%	7%	5%	15%
Wholesale Trade	8%	17%	13%	6%	11%	9%	4%	10%	13%
Retail Trade	0%	7%	10%	0%	6%	9%	0%	2%	6%
Information & Transp.	4%	3%	3%	6%	3%	3%	4%	1%	8%
Services *	29%	59%	48%	76%	60%	56%	63%	54%	48%
Public Administration	4%	0%	0%	0%	3%	3%	0%	3%	0%
Totals	100%	100%	100%	100%	100%	100%	100%	100%	100%

** Services include Professional, Scientific, Technical, Management, Administrative, Support, and Other*

*** Organizations are not required to report out-of-state revenues. These figures reflect voluntarily reported revenues, and undercount actuals.*

Table 9. Business Sector Data by Region

	Northeast	Northwest	Olympia Peninsula	Puget Sound	Southeast	Southwest	Other	Totals
Construction	3	2		24	6	3		38
Info & Trans			1	3	1			5
Manufacturing	7	1	1	10	2		1	22
Pub Admin	1			4				5
Retail	1	1		6		1	1	10
Services	13	3	3	77	11	6	3	116
Wholesale	3	2	1	15	5	2	0	28
Utilities	2			6	1		6	15
Ag & For				1		1		2
Totals	30	9	6	146	26	13	11	241

What is happening in other states?

Data from other states are scarce. Certainly the energy efficiency, renewable energy, and smart energy industries throughout the United States exist and are more than what the meager figures below show, but their strength and compositions do not appear to have been quantified to the extent that this study does for Washington's industries. This report's search covered websites and direct email and telephone contact of state agencies, industry professionals and economists, interest groups, and census data. The following comparable figures, in Table 10, are the results.

Table 10. Clean Energy Industry Data from Other States[18]

State	Industry / Year	# of Orgs	Employees	Avg Wages	Revenues
CO	Renewables / 1997	348	1,875	$38,400	
HI	Energy Efficiency & Renewables / 2001	>27			
IA	Ethanol & Biodiesel (in Biomass) / 2004	16	3,390 (incl. indirect)		$1.96 billion
ME	Biomass / 2005	10			
NV	Geothermal & Solar	10			
OR	Smart	11			
VT	Renewables	73			
WI	Renewables / 2002	254			

In addition, New York started an eight-year economic development program in 1998 focused on energy efficiency, called New York Energy $mart. At the end of 2003, public investment had been $350 million, private had been $850 million, and an average of 3,500 jobs had been created each year above otherwise expected job growth[19].

What is happening outside of clean energy?

Over the same time period, 1997 – 2004, the Washington State economy as a whole went through a large expansion and then a sudden, severe recession. In 2000, at the height of the boom, total Washington employment was 2,931,400. It dropped 90,000 to a low of 2,841,800 in 2002, and it was not until 2004 that employment returned to its previous high[20]. Thus, between 1998 and 2004, Washington State employment increased a net of 0.7 percent. Washington also ranked in the top ten states for average annual earnings during this period. From 1997 through 2004, average wages grew by 24%. Yet the clean energy industry was possibly healthier than the overall economy: in 2004 the Washington State average annual wage was $44,629 while the

clean energy average wage was $58,198. Both Washington's overall and clean energy average wages were greater than the nation's: $40,758[21].

The 1998 study found that the Washington's clean energy industry was larger than the state's wholesale apple industry. In 2004, Washington's clean energy industry was just larger than the state's logging industry, and just smaller than the state's sawmill/lumber mill industry, based on total gross revenues.

Table 11. Other Washington Industries, 2004

Industry	Gross Revenues	# Orgs	Avg Revs per Org
Wineries	$ 552,068,961	134	$ 4,119,918
Agriculture	$ 1,233,870,301	2,249	$ 548,631
Coffee/espresso shops*	$ 1,745,961,082	2,649	$ 659,102
Logging	$ 1,914,492,161	1,557	$ 1,229,603
Clean Energy	$ 2,138,493,292	241	$ 8,873,416
Sawmills, lumber mills	$ 2,302,128,291	117	$ 19,676,310
Trucking total	$ 4,720,428,122	4,293	$ 1,099,564
Software (not retail)	$ 9,542,919,969	4,778	$ 1,997,262

** Note, this is retail shops, not big marketers/roasters*

In terms of the established energy industry, which includes fossil fuel-based and large hydropower energy, census data are spotty but provide the best source for comparisons. The U.S. Census Bureau takes an economic census every five years. The most recent set of data results for Washington State are from 2002. While the data do not capture engineering or construction services specific to established energy sources, significant components of the industries, they do capture utilities, retail, transportation, manufacturing, and wholesale activities that relate exclusively to established energy. As Table 10 illustrates below, the established energy industries in Washington were significantly larger (in 2004) than the clean energy industries (in 2004). Considering the engineering, construction, and other contracted services that are not included in these data, actual differences are even greater. However, average wages appear to be about half of the clean energy industries'.

Table 12. Washington's Established Energy Industries, 2002[22]

	# of Orgs	Employees	Avg Wages	Revenues (in $000s)
Utilities				
Hydroelectric power generation	10	60	*	*
Fossil fuel electric power generation	9	604	$61,998	*
Electric power transmission, control, & distribution	110	3,805	$61,810	*
Natural gas distribution	14	437	$59,938	*
Subtotal Utilities	143	4,906	$61,665	
Retail				
Gasoline stations	2,104	15,854	$15,403	$4,234,400
Heating oil dealers	57	650	$37,183	$217,955
Liquefied petroleum gas (bottled gas) dealers	87	606	$30,015	$139,886
Other fuel dealers	6	4	$17,000	$742
Subtotal Retail	2,254	17,114	$16,748	$4,592,983
Transportation				
Pipeline transportation of natural gas	11	165	$70,976	$114,657
Manufacturing				
Petroleum refineries	6	2,711	$73,945	$6,598,320
Engine, turbine, & power transmission equipment mfg	10	199	$45,101	$28,061
Gasoline engine & engine parts mfg	22	284	$34,754	$40,550
Subtotal Manufacturing	38	3,194	$68,663	$6,666,931
Wholesale				
Petroleum & petroleum products merchant wholesalers	128	1,866	$36,946	$4,319,386
Totals (partial)	2,574	27,245	$32,498	$15,693,957

N.B. These figures are significantly lower than actual due to withheld data, unreported data, and to engineering and other contracting services, such as construction, not being available.

** Withheld to avoid disclosing data for individual companies or because receipts are not collected at this level of detail.*

III. Conclusion

As discussed in *Market and Global Context*, the established energy industries, large hydropower and fossil fuel-based power, remain overwhelmingly dominant in Washington State, the U.S., and world-wide. However, as discussed in the same section, there are both disincentives and barriers to expanding our traditional energy resources and incentives to switching to less energy usage and to emerging renewable energy sources. The disincentives for established energy supplies include the high dollar cost of crude oil, challenges inherent in siting large energy facilities, fossil fuel price volatility, negative environmental impacts, and political instability from depending on oil-rich nations. Incentives encouraging the development of clean energy industries include the local economic benefits, reduced emissions, and a potentially more secure energy infrastructure. Such an economic and political climate indicates growing opportunities for clean energy technologies.

This study shows that Washington State has a good-sized, diverse base of clean energy businesses. The industry's 241 businesses had 2004 gross revenues of over $2.1 billion, more than the state's coffee/espresso shop industry, and they employed almost 8,400 people at an average wage of $60,000. Businesses include private for-profit, private non-profit and public businesses. Approximately half the businesses work in energy efficiency, one fifth in smart energy, and 85% work in one type of renewable energy or another. Many businesses work in more than one clean energy sub-industry. While over half of the businesses, revenues, and employees are located in the Puget Sound region, the northeastern and southeastern regions have substantial clusters of clean energy businesses, as well. In fact, on a per capita basis, the northeastern and southeastern regions are the strongest state-wide in number of jobs and annual revenues. And finally, businesses run the gamut, with 3 sectors represented equally strongly: construction, manufacturing, and services.

It is difficult to know how Washington's clean energy industry compares to other states' due to a dearth of reports even somewhat similar to this one. From the limited information available, Wisconsin and Colorado appear to have robust renewable energy industries, and New York has been investing to foster its clean energy industry. Yet within Washington, the clean energy industry appears to have weathered the 2001-2002 recession well, and in 2004, enjoyed an average salary that was $13,500 more than the state's overall average.

Given Washington State's growing energy demands, its large hydropower sites already built to capacity, and the clean energy industry's diversity and health, the state has a very real opportunity to take advantage of the industry and to invest in clean energy resources to provide electricity for decades to come.

Appendix I: 1997 – 2004 Comparisons and Forecasts

The industry figures from the 1998 study and those from this 2004 update are very different. For instance, the 1998 study reported 274 organizations, while this report shows 191 (adjusted[†]) organizations in comparable industries – a difference of 83 firms. Revenues appear to have risen from $1.1 billion (2004$) to $1.6 billion (adjusted[†]). This occurred primarily in the general renewables category, though the geothermal category saw the greatest increase as a percentage of its 1997 revenues. The number of employees in the studied industries also appears to have grown from 3,802 to 6,530 (adjusted[†]), a difference of 2,728 or 72%. The energy efficiency industry had the greatest potential nominal increase, at 1,363, and general renewables showed the greatest percentage increase. Finally, the average wage appears to have increased from $51,000 (2004$) in 1997 to $59,000 in 2004, 16%. Table 9 on the following pages illustrates the differences between 1997 and 2004.

What might explain these changes in the clean energy industry? Possibly simple industry growth: as discussed in the Market and Global Context section, consumer demand for green energy alternatives is growing both in Washington and throughout the country, and this state had many existing businesses that might have grown or attracted new, related ones. Additionally, Washington utilities have been increasing and diversifying their sources of clean energy. The Northwest Power and Conservation Council analyze electric utility investments in cost-effective energy efficiency resources. Their reports indicate that Northwest utility investments in energy efficiency resources dropped to the lowest levels in two decades during the 1997 – 1999 time period. Where utility investments in efficiency measures were $179 million in 2004, these investments ranged from $69 million to $93 million in the late 1990s. Because utility investments rarely ever pay the full cost of energy efficiency improvements, these utility investments also leverage private sector investments from households, businesses, institutions, and industries. Additionally, the cost of wind power has grown increasingly competitive with natural gas fueled power, which has stimulated the development of wind power. In 2002 Washington's electric utilities included no wind resource in their power generation fuel mix; three years later 22 utilities included wind as one of their resources for power generation, albeit typically a small resource.

However, many of the changes between the 1998 and 2004 studies are likely due to very different methodologies. This follow-up used refined data collection methods, different data cleaning methods, and focused entirely on rigorous quantitative, as opposed to qualitative, analysis.

Table 13. Comparisons of Data with 1997 Results, by Sub-Industry

	1997 *	2004 Adjusted **	Difference	Diff. %	2004 Total

[†] The 241 firms discussed in the body of this report include utilities and smart energy firms, neither of which group was included in the 1998 study. For more accurate comparisons, 2004 data are adjusted by removing utility and smart energy organizations.

All industries	**# of Orgs**	274	219	(55)	-20%	241
	Employees	3,802	6,548	2,746	72%	8,373
	Avg Wage	$50,810	$59,168	$8,359	16%	$59,770
	Total Wages	$193,177,740	$388,562,619	$195,384,879	101%	$501,617,149
	Revenues	$1,111,248,393	$1,663,503,337	$552,254,944	50%	$2,138,493,292

** 1997 dollar figures have been inflated to 2004 values for truer comparisons.*

*** 2004 Adjusted does not include the smart energy industry for an equal comparison with the 1998 study results. 2004 Total includes all data collected for 2004.*

		1997	2004	Difference	Diff. %
Sm Sc Hydro	**# of Orgs**	21	35	14	67%
	Employees	119	278	159	134%
	Avg Wage	$54,428	$69,572	$14,311	26%
	Total Wages	$6,476,952	$19,358,700	$12,650,186	195%
	Revenues	$18,588,756	$60,608,246	$42,019,490	226%
Photovoltaic/ Solar	**# of Orgs**	69	40	(29)	-42%
	Employees	424	389	(35)	-8%
	Avg Wage	$38,848	$63,005	$23,562	61%
	Total Wages	$16,471,476	$24,521,144	$7,818,106	47%
	Revenues	$85,512,849	$188,272,931	$102,760,082	120%
Geothermal	**# of Orgs**	10	17	7	70%
	Employees	0	205	205	
	Avg Wage	n/a	$66,831	n/a	
	Total Wages	$14,436	$13,701,658	$13,687,222	94,813%
	Revenues	$149,172	$35,499,231	$35,350,059	23,698%
Fuel Cells	**# of Orgs**	*The fuel cell sub-industry was not a distinct category in the 1998 study.*	29		
	Employees		510		
	Avg Wage		$53,754		
	Total Wages		$27,406,784		
	Revenues		$192,693,388		

-- Table 11 Continued on Next Page --

Table 13, Continued

		1997 *	2004	Difference	Diff. %
Wind	**# of Orgs**	6	34	28	467%
	Employees	20	111	91	453%
	Avg Wage	$54,315	$73,304	$16,894	31%
	Total Wages	$1,086,309	$8,105,035	$6,787,164	625%
	Revenues	$2,712,765	$43,560,710	$40,847,945	1,506%
Biomass	**# of Orgs**	26	27	1	4%
	Employees	325	181	(144)	-44%
	Avg Wage	$44,196	$68,123	$22,331	51%
	Total Wages	$14,363,820	$12,313,554	-$2,338,579	-16%
	Revenues	$65,250,720	$41,769,157	($23,481,563)	-36%
Efficiency	**# of Orgs**	134	133	(1)	-1%
	Employees	2,895	4,279	1,384	48%
	Avg Wage	$53,139	$58,424	$5,285	10%
	Total Wages	$153,836,031	$258,330,893	$104,494,862	68%
	Revenues	$934,629,948	$878,761,251	-$55,868,697	-6%
General Renewables	**# of Orgs**	8	25	17	213%
	Employees	19	586	567	2,983%
	Avg Wage	$48,880	$55,292	$6,412	13%
	Total Wages	$928,716	$24,315,806	$23,387,090	2,518%
	Revenues	$4,404,183	$220,600,502	$216,196,319	4,909%
Smart	**# of Orgs**	*The smart energy industry was not addressed in the 1998 study.*	48		
	Employees		1,826		
	Avg Wage		$61,927		
	Total Wages		$113,054,530		
	Revenues		$474,989,955		

** 1997 dollar figures have been inflated to 2004 values for truer comparisons.*

- Revenues assume in-state and voluntarily reported out-of-state for the 1998 study data, comparable to this report's Total Revenues.

- 2004 General Renewables include electric vehicles, which were a distinct category in the 1998 study.

- The 10 Unknown organizations (see Table 3), with at least 9 employees, wages of $338,795, and revenues of $1,737,922, are included in only the "All Industries" table.

- The # of Orgs in each of the sub-industries sum to more than 240 because many organizations work in more than one sub-industry. Employees, wages, and revenues have been adjusted to reflect only that attributable to a given sub-industry. Adjustments assume that an organization evenly distributes its work among all sub-industries it is involved in.

So what can be expected for the future? While this study's research did not cover forecasting, the following is culled from several local and national experts.

Worldwide, clean energy investment is expected to be more than $3.5 trillion between 2000 and 2020, averaging over $180 billion per year. Energy efficiency and its related services are forecasted to grow the most[23], which makes sense given the economic benefits of efficiency, discussed in Market and Global Context, and that efficiency does not require switching from established energy sources and infrastructure. Smart energy, one of Washington's most promising industries, is expected to receive investments of $500 billion in the same 20 years[24]. *Clean Energy Trends 2003* published the following global forecasts through 2012 for these sub-industries:

- solar power from $3.5 billion to more than $27.5 billion world-wide,
- wind power from $5.5 billion to more than $49 billion world-wide, and
- hydrogen fuel cells from $500 million to more than $12.5 billion world-wide [25]

Locally, the study *Poised for Profit* predicts for the Pacific Northwest the following by 2020:

- $1 billion will be invested in biomass,
- $1 billion will be invested in small hydro,
- $1 billion will be invested in fuel cells,
- $1.6 billion will be invested in wind,
- $3 billion will be invested in power systems technologies, or smart energy, and
- energy efficiency revenues will be $2 billion[26]

The study asserts that the Pacific Northwest's greatest opportunities for growth will be in fuel cells, smart energy, and photovoltaics/solar. While wind power generation will increase, the revenues from manufacturing wind equipment will still go to where the technologies are already established, in California, Denmark, and Germany, so it would be difficult for Washington, Oregon, or Idaho to enter the market. The geothermal sub-industry is dominated by Philippines, Japan, and Indonesia for geological reasons[27].

In terms of marketing Pacific Northwest clean energy products, *Poised for Profit* concludes that Europe is probably the best, specifically Germany: its consumers are moving that direction and are wealthy, the U.S. already has good economic ties, the country is economically developed, and it is open to private investment. India and Brazil are the second most promising markets: they are large, they have open power sectors, and they are already interested in clean energy. Furthermore, the Pacific Northwest is in a better geographical location than Europe. Transmission, which involves smart energy, is a particular need in India[28].

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